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ABSTRACT

The North Carolina Mathematics and Science Coalition is a statewide organization comprised of education, public policy, civic, community, and business leaders. Coalition members work together in a forum to stimulate and promote efforts to implement systemic reforms in mathematics and science education in North Carolina. The Coalition's overall purpose is to focus the efforts of diverse groups into working together to bring excellence to mathematics and science education across the state. This publication of the Coalition's initial goals begins with a vision statement, followed by a list of the many stakeholders needed to help make the vision a reality. The list of initial goals includes: (1) involve all students in developing high learning expectations that foster improved learning, performance, and participation at all levels of mathematics and science, pre-K to college; (2) develop mathematics and science lead teachers who serve as resources, model teachers, and catalysts for change at the school and system levels; and (3) provide schools with teachers who reflect diversity, are prepared to teach mathematics and science, and are professionally committed to lifelong learning in these disciplines. Each goal description includes an explanation of essential components and a list of targeted outcomes. (PVD)

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A Shared Vision for Mathematics and Science Education in North Carolina

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Mathematics and Science Coalition

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The North Carolina Mathematics & Science Coalition

The North Carolina Mathematics and Science Coalition is a statewide organization of education, public policy, civic, community, and business leaders. Coalition members work together as a forum to stimulate and promote efforts to implement systemic reforms in mathematics and science education in North Carolina. The Coalition's overall purpose is to focus the efforts of diverse groups of stakeholders whose working together can bring excellence to mathematics and science education across the state.

Setting a Vision

The Coalition believes that all students need the level and quality of mathematics and science education that successfully prepares them to:

- ★ Use mathematics and science regularly to evaluate and solve a wide variety of problems,
- ★ Pursue further education in mathematics and science studies,
- ★ Assume civic responsibilities by understanding mathematics and science issues affecting a global society, and
- ★ Participate in a dynamic and internationally competitive economy.

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The North Carolina Mathematics & Science Coalition

Moving from Vision to Reality

For this vision to become reality, a concerted effort must be initiated among all stakeholders at the local, regional, and state levels. We need shared agreement on what it means to know and be able to do mathematics and science and a common set of purposes and directions that foster long-term improvements and systemic change. Such an effort involves many different stakeholders, including:

- ★ Students who participate fully in their learning experiences by using and exploring mathematics and science.
- ★ Teachers who are well prepared to teach mathematics and science and understand its importance and relevance in a complex society.
- ★ Parents who work with educators and civic, community, and business leaders to ensure that all children receive a quality and useful mathematics and science education.
- ★ School Boards and Administrators who are well informed about reform efforts and are willing to involve all segments of the community in supporting mathematics and science programs.
- ★ Policy Makers and Elected Officials who strive to guarantee an up-to-date, comprehensive mathematics and science program for every student.
- ★ Business and Industry Leaders who communicate the mathematical, scientific, and technological needs of the work place to the stakeholders and provide both tangible and in-kind resources and support to schools and school systems.
- ★ Professional and Civic Organizations that engage in community outreach programs, publicly recognize excellent teachers and model programs, and encourage students in their study of mathematics and science.
- ★ College and University Faculties who prepare teachers committed to life-long learning and classroom leadership, spend time working with teachers and students, and collaborate with teachers and administrators in designing mathematics and science programs.
- ★ Technical and Community College Faculties who recruit and graduate diverse, well-trained students who can compete in a global work force and are competent to meet the changing needs of business.

Establishing Initial Goals

To move forward to achieve this vision, the North Carolina Mathematics and Science Coalition has identified an initial set of eight goals:

Success in Mathematics and Science Learning for All Students

Involve all students in developing high learning expectations that foster improved learning, performance, and participation at all levels of mathematics and science, pre-K to college.

Time to Teach and Time to Learn

Increase the professional time available for teachers and students to work together; for teachers, students, and parents to interact; and for teachers to plan and evaluate their own teaching, consult with colleagues and supervisors about teaching effectiveness, and participate in ongoing professional education programs.

Instructional Leadership

Develop mathematics and science lead teachers who serve as resources, model teachers, and catalysts for change at the school and system levels.

Curricula, Materials, and Tools for Teaching

Provide the instructional materials, supplies, and equipment needed to engage students' natural curiosity about the world around them and their natural inclination to solve problems in mathematics and science.

Assessment and Learning

Develop state and local assessment programs that incorporate state and national standards developed for mathematics and science, use a variety of strategies that reflect the philosophy of the discipline, and effectively evaluate schools on the basis of student performance.

Parent and Community Participation

Raise expectations and increase involvement of parents, guardians or other care-givers, and community stakeholders as full and active partners in mathematics and science education reform.

Preparation and Continuing Professional Development of Mathematics and Science Teachers

Provide schools with teachers who reflect diversity, are prepared to teach mathematics and science, and are professionally committed to life-long learning in these disciplines.

University, College, and Community College Teaching of Mathematics and Science

Alter the content and delivery of undergraduate mathematics and science instruction to be consistent with the K-12 reform philosophy.

The vision statement clearly defines a shared responsibility for achieving these goals and recommends targeted outcomes for each goal. Working together to achieve the targeted outcomes will reduce duplication and yield greater influence in operational, political, economic, and social centers.

Goal: Success in Mathematics & Science Learning for All Students

Involve all students in developing high learning expectations that foster improved learning, performance, and participation at all levels of mathematics and science, pre-K to college.

Essential Components

Students can learn to reason and solve problems, to make connections, and to communicate mathematically and scientifically. They must understand and be able to use mathematics and science principles and applications in everyday work and as responsible citizens.

Unfortunately, students do not have equal access to a common core of quality mathematics and science education. Traditional practices that define access to mathematics and science through student grouping solely by achievement tests, and not by educational needs, limit their choices for learning mathematics and science.

Targeted Outcomes

- ★ Help students, parents, and teachers understand that it is critical to expect success in mathematics and science and recognize that early choices affect their educational and career paths.
- ★ Provide assistance to teachers in developing alternative strategies that promote participation of all students in mathematics and science.
- ★ Eliminate below-grade-level courses, and integrate life-skill uses of mathematics and science in core courses.
- ★ Provide common core curricula in mathematics and science in which students are organized by such purposes as time needed to learn or learning styles and not by curriculum goals.
- ★ Provide flexible grouping strategies to address the changing needs of students.
- ★ Create support for success in mathematics and science achievement by raising parent and student expectations.

Goal: Time to Teach and Time to Learn

Increase the professional time available for teachers and students to work together; for teachers, students, and parents to interact; and for teachers to plan and evaluate their own teaching, consult with colleagues and supervisors about teaching effectiveness, and participate in ongoing professional education programs.

Essential Components

The school schedule and the demands of teaching do not afford teachers quality time to work together and engage in professional development activities. Teachers often can respond only in a "reactive mode" during the school day and have little time to reflect on their work as it is being accomplished. Often, designated instructional time is used for other purposes. Inquiry and hands-on teaching require quality time to plan and learn and necessitate collaboration with other teachers, and practicing mathematicians, scientists, and engineers.

Students learn at different rates and in different ways and many need access to teachers or other instructional assistance in addition to regular classroom time. While teachers give substantial time to their tasks away from school, this extra effort is seldom recognized by or factored into the public's or policymakers' percpetion, thinking and planning.

Targeted Outcomes

★ Provide time during the school day for teachers to plan work, participate in professional development activities, and interact with students, colleagues, parents, and the community.

★ Provide flexibility to improve instructional delivery by eliminating the rigid school day and using only teachers as instructors through such options as:

- *Initiate volunteer programs after school in which adult and student tutors assist students with mathematics and science work and projects.*
- *Use part-time and retired teachers on an as-needed basis in the instructional program.*
- *Restructure time by altering the calendar, school day period length, or teaching schedule.*
- *Establish "common" planning times to support collaboration.*
- *Make more effective use of time already scheduled for faculty meetings and staff development.*
- *Allow teachers greater autonomy in managing their time.*

Goal: Instructional Leadership

Develop mathematics and science lead teachers who serve as resources, model teachers, and catalysts for change at the school and system levels.

Essential Components

New and demanding standards for teaching and learning require that students have highly qualified teachers who can effect the changes necessary to develop students' thinking skills and problem-solving abilities. In-house resource personnel (e.g. lead teachers) can assist faculty members in developing their knowledge and teaching expertise. This role may vary from school to school depending on individual school needs and resources. It may include such responsibilities as:

- *Leading professional development opportunities in mathematics or science education;*
- *Sharing successful and innovative strategies for instruction and assessment;*
- *Participating in the selection and design of curricula, materials, and tools for teaching;*
- *Assisting the principal in communicating about mathematics or science education.*

Targeted Outcomes

- ★ Work with principals and school administrators to support the use of lead teachers in science and mathematics education.
- ★ Develop certification programs that recognize teachers with leadership expertise in science or mathematics education at the school level.
- ★ Provide release-time and financial support for teachers to participate in professional development activities as well as access to leadership resource materials.
- ★ Involve community and business resources in developing and providing the leadership necessary to ensure student learning and achievement.
- ★ Develop, incorporate, and require leadership development courses and activities in undergraduate and graduate curricula at institutions of higher education.

Goal: Curricula, Materials, and Tools for Teaching

Provide the instructional materials, supplies, and equipment needed to engage students' natural curiosity about the world around them and their natural inclination to solve problems in mathematics and science.

Essential Components

State mathematics and science curricula should reflect the national standards developed for inquiry-based learning. The curricula should include the standards completed by the National Council of Teachers of Mathematics and those being prepared by the National Committee on Science Education Standards and Assessment.

The curricula should promote the involvement of students in activities leading to the understanding of mathematical and scientific concepts and skills. Students should be engaged in problem-solving, communication, reasoning, and the making of broad mathematical and scientific connections between and within disciplines. Modern technology for experimentation and discovery is needed at all levels.

Targeted Outcomes

- ★ Define mathematics and science standards, acceptable to business and industry, that make students more employable.
- ★ Provide teachers with assistance in developing their own curricula and provide easier access to revised curricula and professional development and assist in its use.
- ★ Expand the legal definition of textbooks to allow the use of funds to purchase a wide variety of support media and alternative print materials.
- ★ Provide every student and teacher with a grade-appropriate calculator and every class with access to current technologies for experimentation, visualization, simulation, and computation.
- ★ Provide teachers and students with regular access to science materials that promote hands-on learning and problem-solving abilities.
- ★ Provide teachers with professional development programs that teach them how to integrate the use of current technologies, including calculators, computers, and scientific measuring devices.

Goal: Assessment and Learning

Develop state and local assessment programs that incorporate state and national standards developed for mathematics and science, use a variety of strategies that reflect the philosophy of the discipline, and effectively evaluate schools on the basis of student performance.

Essential Components

State-mandated tests often focus too narrowly by measuring low-level skills and knowledge as opposed to measuring what students know, are able to do, and think about mathematics and science. Standardized tests can reinforce poor educational practices, particularly in schools serving economically disadvantaged students.

Most current assessment devices do not adequately measure a student's ability to think and solve problems. Factual recall assessments do not promote teaching methods that use hands-on learning or develop thinking skills and problem-solving abilities. Paper and pencil tests often provide students with negative feedback on achievement and ability to learn and do not adequately measure their range of learning.

Targeted Outcomes

- Develop, implement, and evaluate appropriate assessment programs at all grade levels.
- Construct assessment instruments that measure knowledge, capabilities, and attitudes toward mathematics and science.
- Treat assessment as an integral part of the teaching process.
- Provide professional development for teachers and administrators on effective evaluation and assessment of student achievement.
- Implement multiple assessment techniques that focus on conceptual understandings of mathematics and science.
- Use calculators, computers, and a variety of other tools and materials as part of assessment procedures.

Goal: Parent and Community Participation

Raise expectations and increase involvement of parents, guardians or other care-givers, and community stakeholders as full partners in mathematics and science education reform.

Essential Components

We have the opportunity to expand regional, statewide, and national outreach efforts to achieve educational excellence in mathematics and science. Such reform and long-term improvements require that individuals from all segments of our population become involved and take responsibility to improve the educational system. Regional and local leadership can play a major role by mobilizing the unique resources within their communities.

Targeted Outcomes

- ★ Promote participation of parents, guardians, or other care-givers in their children's educational planning.
- ★ Shift power from the state to regional and local authorities.
- ★ Develop guidelines for communities to use in assessing local needs and mobilizing local resources.
- ★ Implement multiple assessment techniques that focus on conceptual understandings of mathematics and science.
- ★ Identify strong regional and local leadership to help develop support for the drive toward excellent mathematics and science teaching.
- ★ Encourage parental and community involvement in all aspects of the design and implementation of educational improvements.
- ★ Introduce students to the economic impact education has on their lives by providing learning experiences, such as field trips, guest visitors, and "days on the farm, in the factory, or at the office".
- ★ Develop partnerships between the private sector and the educational system to provide students with "real life" experiences.

Goal: Preparation & Continuing Professional Development of Mathematics and Science Teachers

Provide schools with teachers who reflect diversity, are prepared to teach mathematics and science, and are professionally committed to life-long learning in these disciplines.

Essential Components

Many teachers are not prepared to teach mathmatics or science to students as envisioned by national and state standards. Lateral entry and other alternative certification programs do not always provide sufficient content and pedagogical knowledge to prepare teachers for the classroom.

Numerous opportunities for professional development exist. However, they need to be more clearly defined in order to address specific needs. Additionally, there needs to be a significant increase in the number of teachers being served. Professional development is ongoing throughout a teacher's career, although many current practices do not reflect this premise. Teachers, like other professionals, require support from their employers to pursue continuing education and professional development opportunities.

Targeted Outcomes

- Unite the Department of Public Instruction, schools, and school districts that are committed to educational excellence with those having a stake in the schools and higher education.
- Redesign curricula for prospective teachers to ensure that they are broadly educated in their fields, can integrate topics in science and mathematics, and can craft successful learning experiences for their students.
- Provide learning experiences for teachers that reflect both valued teaching behaviors and the use of technology.
- Grant provisional certification to beginning teachers and design methods to support and continue their education before granting five-year certification.
- Support the continuing education of teachers by making courses available while they are on contract or by providing stipend support.
- Expand professional development programs to all regions of the state by using new technologies, broadening the base of instructional leadership, and actively involving all teachers in such activities.
- Require one or more substantial courses or activities on an ongoing basis for re-certification.
- Allocate a minimum of 1% of school system budgets for professional development, paralleling the practice in the business community.

Goal: University, College, and Community College Teaching of Mathematics & Science

Alter the content and delivery of undergraduate mathematics and science instruction to be consistent with pre-college reform philosophy.

Essential Components

Teachers at all levels need better preparation to teach conceptual, inquiry-oriented mathematics and science. Too often, teaching excellence is not included in reward structures. University, college, and community college faculty need to be rewarded for preparing new curricula and working with undergraduate teachers and non-science majors.

Targeted Outcomes

- ★ Examine and revise mathematics and science curricula for both non-majors and prospective teachers of mathematics and science.
- ★ Provide effective professional development programs for university and college faculty that address content, teaching strategies, and use of technology.
- ★ Grant professional service credits to faculty who work in carefully designed teacher in-service programs or in sustained professional development programs for public school teachers of science and mathematics.

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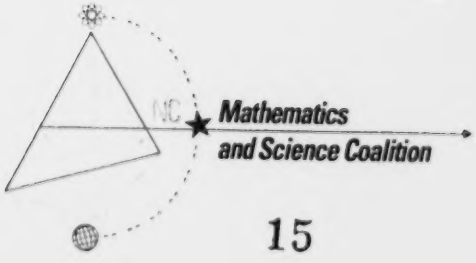

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